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**STUDY OF MESOSCALE EXCHANGE  
PROCESSES UTILIZING LANDSAT  
AIR MASS CLOUD IMAGERY**

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## PREFACE AND SUMMARY

Small scale cumulus associated with both tropical and polar air masses over the central United States as observed in LANDSAT images are being analyzed. The objective of the analysis is to define relationships between the spacing and density of the cumuliform cloudiness and major terms of the surface energy and water budgets.

A visual analysis of cloud cover and albedo on two of the three LANDSAT images selected yielded a weak relationship between high albedo and high cumulus concentration.

LANDSAT CCT's have been received for the selected cases, although no data have been received from the ground truth test sites. Climatological data from cooperative climatological stations have been collected and punched on computer cards.

Computer algorithms necessary to read and printout selected portions of CCT's have been developed. An algorithm to translate calibrated voltage counts into albedo has been completed. Algorithms have also been prepared to calculate the heat and moisture budget of the surface from available climatological observations. Albedo maps have been produced and heat and moisture budget calculations have been performed for the areas of two selected LANDSAT images.

## 1.0 WORK ACCOMPLISHED DURING THIS PERIOD

### 1.1 Selection of Case Studies

We have selected two occurrences of cumuliform clouds as shown by LANDSAT images for the calculation of surface heat and moisture budgets. The selected case studies are 24 May 1974 (LANDSAT-1 Scene ID 167016331), and 3 July 1975 (LANDSAT-2 Scene ID 216216282). Both occurrences are around the area of Manhattan, Kansas.

### 1.2 Calculation of Albedo Maps

Albedo maps on an approximate scale of 1:250,000 have been produced for the two cases selected. Albedos range from 20% to 35% over land and are at about 5% over water bodies. Each albedo value is for an area approximately 1 mile square and is an average of 16 scan spots.

### 1.3 Heat and Moisture Budget Calculations

Climatological data from all available climatic stations (22) in the area covered by the two LANDSAT images have been used to calculate heat and moisture budgets from about two weeks prior, up to the time of the two selected cumuliform cloud scenes.

The soil moisture budget calculations provide the moisture available in three top layers of the soil up to the time of the LANDSAT scene, by taking into account precipitation, evaporation, and runoff for about two weeks prior to the scene. The calculations have been performed by a method called the Versatile Budget (VB) developed by Baier and Robertson (1966) and slightly modified by EarthSat.

Concurrent with the soil moisture budget, heat budget calculations have also been performed for the climatic stations located in the LANDSAT scenes. The heat budget subroutine provides the net radiation values necessary for the evaporation estimation. As a result of the moisture and heat budget calculation at the 22 climatic stations we will shortly have available for the area of the LANDSAT images:

1. A map of soil moisture at the time of the LANDSAT image.
2. A map of evaporation approximately  $\pm$  3 hours of LANDSAT image.
3. A map of solar and net radiation approximately  $\pm$  3 hours of LANDSAT image. (Actual LANDSAT cloud cover are used to estimate solar radiation.)

#### 1.4 Precipitation Map Analysis

Two types of precipitation maps have been prepared for the two LANDSAT image areas using all available climatological data. One map shows the number of days since it rained last from the time of the LANDSAT image. Another map shows the total precipitation received in the seven days prior to the LANDSAT image.

## 2.0 PROGRAM FOR NEXT REPORTING PERIOD

During the next three-month reporting period we will conduct the following:

1. Plot on a 1:1,000,000 scale values of soil moisture, evaporation, and radiation we have obtained for the climatic stations in the two selected LANDSAT images.
2. Initiate correlation analyses of heat and moisture budget and cloud fields.

### 3.0 DATA USE

In the investigation to date we have the following data use summary:

1. Value of Data Allowed

Bulk        768

CCT        9600

2. Value of Data Ordered

Bulk        350

CCT        2400

3. Value of Data Received

Bulk        200

CCT        2400